

# Designing a Teachable Agent with Social Intelligence

Annika Silvervarg<sup>1</sup>, Agneta Gulz<sup>1</sup>, Magnus Haake<sup>2</sup>, Björn Sjöden<sup>2</sup>, Betty Tärning<sup>2</sup>

<sup>1</sup> Dept. Computer and Inform. Science, Linköping University, 581 83 Linköping, Sweden

<sup>2</sup> Cognitive Science, Lund University, Kungshuset, Lundagård, 222 22 Lund, Sweden

{annsi, agngu}@ida.liu.se, {magnus.haake, bjorn.sjoden, betty.tarning}@lucs.lu.se

We are building a learning environment that includes an embodied intelligent agent capable of both task-directed and social interaction with users. The starting point is an existing educational math game developed by L. Pareto and D. Schwartz, in which a teachable agent plays a crucial role. AI algorithms allow the agent to learn by observing and posing multiple-choice questions to the user regarding the game play.

We are extending this game with a module for freer conversation about topics related to the domain, eg. the math game, school, math, but also other topics such as music, sports, family and friends. The purpose of this is to a) enable the user develop a relationship and establish trust with the agent, b) enrich the game and its motivational qualities for the age group in question, c) explore whether such a conversational module can enable pedagogical interventions, such as supporting students math self efficacy and change negative attitudes toward math in general. A tight interrelation of i) a task-oriented *teachable agent*, being an *integral part* of an educational game – in contrast to a pedagogical agent that is added to a system – and ii) a social conversational module is to our knowledge a novel endeavor, for details see [4].

Here will focus on how we can design the agent to be perceived as social intelligent enough in the setting that the learning environment poses. Walker [3] states that “socially intelligent conversational behaviors arise from the interaction of a number of different factors: the conversants’ personality, cultural knowledge, the ability to observe and reason about social relationships, and the ability to project and detect affective cues”. We focus on personality, knowledge and affective cues.

Rather than designing a complex and knowledge intense architecture we aim at reaching our goal of a socially intelligent conversational agent through simple means and techniques, for example the conversational module is based on chatbot architecture. We have taken a very pragmatic approach, which includes iteratively applied user-centered agile system development methods combining focus group interviews and Wizard-of-Oz role-play with development and evaluation of prototypes through surveys and analysis of natural language interaction logs. For the present project, the target group is 12-14-year-old students, and several school classes of 13-14 year old students are taking active part in the development.

**Visual characteristics and animation** We explicitly avoid a naturalist or even semi-naturalist style for pedagogical agent representation. The main reason is that we want to downplay expectations that students may have relating to the agent behaving and conversing *just like* a human being. Another aspect is that cartoon-like character easily can convey affective cues through simple animation of body and face [2]. The ability for the agent to smile when the user jokes or says something ironically, also adds to the agent’s ability of appearing socially intelligent.

**Knowledge profile** When we introduce an agent whose conversation capacities expands from a limited, domain-specific and task-oriented conversation to a broader, human-like social conversation, the challenge of creating an appropriate knowledge profile becomes considerably more complex. However, through the focus groups interviews, the role-play and analysis of logs of interaction with a prototype, we have step by step discovered a number of topics that the majority of questions relate to:

- **Focus Group and WoZ:** Mathgame, Math, School, Family, Friends, Free-time, Film, Music, Books, Computer games, Sports, Personal information
- **Iteration 1:** In addition: Food, Animals, School subjects
- **Iteration 2:** In addition: TV

Initial analysis of dialogue logs and subjective assessments through surveys show that we are moving in the right direction, but that there is still big room for improvement. For example, on a 7 point Likert scale the mean value for the question “I had many things to talk to the agent about” was 2,0 in iteration 1 and 3,2 in iteration 2. This question strongly correlates to the questions “I liked talking to the agent” ( $r=0,84$ ,  $p<0,01$ ) and “It was fun talking to the agent” ( $r=0,77$ ,  $p<0,01$ ).

**Social profile and Personality** To be perceived as believable and intelligent the agent must meet users’ expectations regarding general personal features, in terms of being kind or mean, extrovert or introvert, humorous or serious, etc. The design of the agent’s personality is therefore crucial and must be consistently expressed in visual appearance, body language as well as verbal language. Initial investigations into agent personality consisting of focus group discussions and surveys has given us a profile for a desirable personality, for example, with high ranking of extroversion and agreeableness. However, evaluations of perceived agent personality in prototype 1 and 2 indicates a need for a more explicitly expressed personality in the dialogue.

**Communicative abilities** The conversational module is implemented in AIML extended with capabilities for basic dialogue management. The agent’s verbal responses to user utterances and initiatives are designed to conform with the agent’s personality, through length of utterance, lexical and syntactical choices etc. To contribute to perceived social intelligence we also plan to use anecdotes and narrative storytelling. As evidenced by Bickmore and Cassell [1] anecdotes and small-talk have a social and trust-building function also when the interlocutor is a virtual character. At the same time they can convey things related to a knowledge domain, in our case school and mathematics. An agent may, for instance, tell a story about what happened to her aunt who detested math at school but now works as a mathematician.

## References

1. Bickmore, T., Cassell, J.: 'How about this weather'. Proc. of the AAAI Fall Symposium on "Narrative Intelligence", pp. 4--8. Cape Cod, MA (2000)
2. Paiva, A., Dias, J., Sobral, D., Aylett, R., Sobreperéz, P., Woods, S., Zoll, C., Hall, L.: Caring for Agents and Agents that Care. Proc. of the 3rd International Joint Conference on Autonomous Agents, pp 194--201, New York (2004)
3. Walker, A.: Endowing Virtual Characters with Expressive Conversational Skills. In: IVA 2009. LNCS, vol. 5773, pp. 1--2. Springer, Heidelberg (2009)
4. Gulz, A, Silvervarg, A & Sjöden, B.: Design for off-task interaction – Rethinking pedagogy in technology enhanced learning. Proc. of the 10<sup>th</sup> IEEE International Conf. on Advanced Learning Technologies (2010)